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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/731,482	12/10/2003	Joon Hyeon Lee	P69372US0	5381
47604	7590	01/25/2005	EXAMINER	
PIPER RUDNICK LLP			GURLEY, LYNNE ANN	
P. O. BOX 9271			ART UNIT	
RESTON, VA 20195			PAPER NUMBER	
			2812	

DATE MAILED: 01/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/731,482

Applicant(s)

LEE, JOON HYEON

Examiner

Lynne A. Gurley

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 09 November 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4, 6 and 7 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6 and 7 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.


**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

  
LYNNE A. GURLEY  
PRIMARY PATENT EXAMINER  
TC 2800, AU 2812

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                    | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date. _____ | 6) <input type="checkbox"/> Other: _____  |

### DETAILED ACTION

This Office Action is in response to the amendment filed 11/9/04.

Currently, claims 1-4 and 6-7 are pending.

#### *Specification*

1. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

#### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Brown et al. (US 6,541,320, dated 4/1/03, filed 8/10/01).
4. Brown shows the method as claimed in figures 2A-2E and corresponding text, as: depositing a metal line layer 54 having a plurality of conductive layers (column 3, line 67; column 4, lines 1-5) on a semiconductor structure 50 (column 3, lines 13-60);

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depositing and patterning a photosensitive material 56 on the metal line layer; etching at least one conductive layer of the plurality of conductive layers using the photosensitive material as a mask (figure 2B); forming a side wall oxide film 60 on a side wall of the at least one conductive layer of the etched conductive layers (figure 2C); and etching the non-etched conductive layer of the conductive layers constituting the metal line layer (figures 2D-2E). An insulating film as a hard mask is further formed between an uppermost layer of the metal line layer and the photosensitive material (column 4, lines 47-57, lines 65-67; column 5, lines 1-3). The uppermost layer of the semiconductor structure is formed out of an oxide film (column 3, lines 13-60).

5. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Tsou et al. (US 6,509,219, dated 1/21/03, filed 8/10/01).

6. Tsou shows the method as claimed in figures 1-6 and corresponding text, as: depositing a metal line layer 14 having a plurality of conductive layers (column 4, lines 21-53) on a semiconductor structure 10 (column 3, lines 37-67; column 4, lines 1-20); depositing and patterning a photosensitive material 16 on the metal line layer; etching at least one conductive layer of the plurality of conductive layers using the photosensitive material as a mask (figure 3); forming a side wall oxide film 24 on a side wall of the at least one conductive layer of the etched conductive layers (figure 4); and etching the non-etched conductive layer of the conductive layers constituting the metal line layer (figures 5-6). An insulating film as a hard mask is further formed between an uppermost layer of the metal line layer and the photosensitive material (column 4, lines 54-67; column 5,

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lines 1-14). The uppermost layer of the semiconductor structure is formed out of an oxide film (column 3, lines 65-67; column 4, lines 1-21).

7. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Ku et al. (US 6,528,363, dated 3/4/03, filed 3/19/01).

Ku shows the method as claimed in figures 1-6 and corresponding text, as: depositing a metal line layer 14 having a plurality of conductive layers (column 4, lines 21-53) on a semiconductor structure 10 (column 3, lines 37-67; column 4, lines 1-20); depositing and patterning a photosensitive material 16 on the metal line layer; etching at least one conductive layer of the plurality of conductive layers using the photosensitive material as a mask (figure 3); forming a side wall oxide film 24 on a side wall of the at least one conductive layer of the etched conductive layers (figure 4); and etching the non-etched conductive layer of the conductive layers constituting the metal line layer (figures 5-6). An insulating film as a hard mask is further formed between an uppermost layer of the metal line layer and the photosensitive material (column 4, lines 54-67; column 5, lines 1-14). The uppermost layer of the semiconductor structure is formed out of an oxide film (column 3, lines 65-67; column 4, lines 1-21).

### ***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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9. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claims 1-2 and 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lyons et al. (US 6,214,737, dated 4/10/01) in view of Brown et al (US 6,541,320, dated 4/1/03, filed 8/10/01) and further in view of Lo (Us 5,726,102, dated 3/10/98).

11. Lyons shows the method as claimed in figures 1-5 and corresponding text, as: depositing a metal line layer 12 having a plurality of conductive layers (column 3, lines 10-35) on a semiconductor structure 10 (column 3, lines 10-20); depositing and patterning a photosensitive material 14 on the metal line layer; etching at least one conductive layer of the plurality of conductive layers using the photosensitive material as a mask (figure 2); forming a side wall oxide film 18 on a side wall of the at least one conductive layer of the etched conductive layers (figure 3); and etching the non-etched conductive layer of the conductive layers constituting the metal line layer (figures 4-5). At least one of the conductive layers is made of Al (column 3, lines 10-35). The uppermost layer of the semiconductor structure is formed out of an oxide film (column 3, lines 10-20).

12. Lyons lacks anticipation only in not teaching that: 1) an insulating film as a hard mask is further formed between an uppermost layer of the metal line layer and the

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photosensitive material; 2) The insulating film is a nitride film, and the metal line layer is formed by laminating Ti/TiN//Al//Ti/TiN layers in this order; and 3) the insulating film is dry etched using activated plasma comprising a combination of CHF<sub>3</sub>/CF<sub>4</sub>/Ar or CxF<sub>x</sub> (where x, y are natural numbers)/O<sub>2</sub>/Ar gas.

13. Brown teaches an insulating hard mask used underneath and in combination with the resist to pattern the metal layer. The mask may be a nitride (column 4, lines 35-57).

Lo teaches a conventional metal patterning method for a stack of Ti/TiN//Al//Ti/TiN layers (column 6, lines 38-57). Patterning is done by dry etch using a resist mask.

It would have been obvious to one of ordinary skill in the art to have used an insulating film as a hard mask formed between an uppermost layer of the metal line layer and the photosensitive material and to have had the insulating layer be a nitride film, in the method of Lyons, with the motivation given in Brown that the hard mask layer, which may be a nitride, is conventional and additionally it increases the accuracy of the etching step.

It would have been obvious to one of ordinary skill in the art to have had the metal line layer formed by laminating Ti/TiN//Al//Ti/TiN in this order, in the method of Lyons, with the motivation given by Lo that this metal stack is conventional, with the Ti/TiN layer serving as adhesion and barrier layers to the underlying and overlying layers in the device.

It would have been obvious to one of ordinary skill in the art to have had the insulating film be dry etched using activated plasma comprising a combination of CHF<sub>3</sub>/CF<sub>4</sub>/Ar or CxF<sub>x</sub> (where x, y are natural numbers)/O<sub>2</sub>/Ar gas, in the method of

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Lyons, with the motivation that these are well known metal etchants which would work alternatively, in combination, to etch the claimed metal stack.

14. Claims 3-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lyons et al. (US 6,214,737, dated 4/10/01) in view of Brown and Lo (as applied to claims 1-2 above), further in view of Lo (US 5,726,102, dated 3/10/98), and Takada et al. (US 5,435,563, dated 9/21/82).

15. Lyons in view of Brown and Lo shows the method substantially as claimed (as applied to claims 1-2) and as described in the previous paragraphs.

16. Lyons in view of Brown and Lo lacks anticipation only in not teaching that: 1) the metal line layer is formed by laminating Ti/TiN//Al//Ti/TiN in this order, the sidewall oxide film is Al<sub>2</sub>O<sub>3</sub>, the non-etched conductive layers are the first, lowermost Ti/TiN layer; and 2) The Ti/TiN layers are dry-etched using activated plasma comprising Cl<sub>2</sub>/BCl<sub>3</sub>/N<sub>2</sub> gas.

Lo teaches a conventional metal patterning method for a stack of Ti/TiN//Al//Ti/TiN layers (column 6, lines 38-57). Patterning is done by dry etch using a resist mask.

Takada teaches a method of dry etching an Al metal film, wherein an Al<sub>2</sub>O<sub>3</sub> protective sidewall layer is formed during a partial etch of the Al. This sidewall is used as a mask to etch the remaining Al layer.

17. It would have been obvious to one of ordinary skill in the art to have had the metal line layer formed by laminating Ti/TiN//Al//Ti/TiN in this order, to have had the sidewall oxide film be Al<sub>2</sub>O<sub>3</sub>, and to have had the non-etched conductive layers be the



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first, lowermost Ti/TiN layer, in the method of Lyons, with the motivation given by Lo that this metal stack is conventional, with the Ti/TiN layer serving as adhesion and barrier layers to the underlying and overlying layers in the device. It would have been obvious to one of ordinary skill in the art to have substituted the Al<sub>2</sub>O<sub>3</sub> sidewall protection film taught in Takada, for the sidewall oxide shown in Lyons, with the motivation that Takada teaches a method using the partial etching wherein the Al<sub>2</sub>O<sub>3</sub> sidewall layer is used equivalently to the sidewall oxide in Lyons, with the same result. It also would have been obvious to one of ordinary skill in the art to have had the Ti/TiN layers dry-etched using activated plasma comprising Cl<sub>2</sub>/BCl<sub>3</sub>/N<sub>2</sub> gas, in the method of Lyons, with the motivation given in Lo, that these etchants are well known for use on the claimed combination of metal layers, as noted in Lo (column 8, lines 9-17 and lines 37-52. Also see examples).

18. Claims 2-4 and 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsou et al. (US 6,509,219, dated 1/21/03, filed 8/10/01) in view of Lo (US 5,726,102, dated 3/10/98) and further in view of Takada et al. (US 4,350,563, dated 9/21/82).

Tsou shows the method substantially as claimed and as described in the preceding paragraphs.

Tsou lacks anticipation only in not teaching that the conductive layer is made of aluminum, the claimed metal Ti/TiN//Al//Ti/TiN stack, the Al<sub>2</sub>O<sub>3</sub> sidewall oxide layer, and the etchants.

Lo teaches the claimed metal stack and the BCl<sub>3</sub> combination of etchants.

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Takada teaches the  $Al_2O_3$  sidewall protection layer.

It would have been obvious to one of ordinary skill in the art to have had the metal line layer formed by laminating Ti/TiN//Al//Ti/TiN in this order, in the method of Tsou, with the motivation given by Lo that this metal stack is conventional, with the Ti/TiN layer serving as adhesion and barrier layers to the underlying and overlying layers in the device.

It would have been obvious to one of ordinary skill in the art to have substituted the  $Al_2O_3$  sidewall protection film taught in Takada, for the sidewall oxide shown in Tsou, with the motivation that Takada teaches a method using the partial etching wherein the  $Al_2O_3$  sidewall layer is used equivalently to the sidewall oxide in Tsou, with the same result. It also would have been obvious to one of ordinary skill in the art to have had the Ti/TiN layers dry-etched using activated plasma comprising  $Cl_2/BCl_3/N_2$  gas, in the method of Tsou, with the motivation given in Lo, that these etchants are well known for use on the claimed combination of metal layers, as noted in Lo (column 8, lines 9-17 and lines 37-52. Also see examples).

It would have been obvious to one of ordinary skill in the art to have had the insulating film be dry etched using activated plasma comprising a combination of  $CHF_3/CF_4/Ar$  or  $C_xF_y$  (where x, y are natural numbers)/ $O_2/Ar$  gas, in the method of Tsou, with the motivation that these are well known metal etchants which would work alternatively, in combination, to etch the claimed metal stack.

***Response to Arguments***

19. Applicant's arguments, see the amendment, filed 11/9/04, with respect to the rejection(s) of claim(s) 1-2 under 35 U.S.C. 102 with Lyons et al. have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Lyons in view of Brown and Lo pertaining to claims 1-2 to provide motivation for the insulating film.

20. Applicant's arguments filed 11/9/04, regarding the 35 U.S.C. 102 rejections using Brown, Tsou and Ku have been fully considered but they are not persuasive.

21. In response to Applicant's remarks, page 6, although the photosensitive material is claimed as removed after etching the insulating film, the exact point after the etching step is not claimed, therefore, Brown, Tsou and Ku, by conventional photolithographic techniques, still anticipate the limitation.

22. In response to Applicant's remarks, page 6, regarding Tsou and Ku, the insulating film is taught in each of the references as the hard mask and then the photosensitive layer is formed on top of the insulating film (i.e. Brown, column 4, lines 28-54). Alternatively, the mask could be just photoresist by itself (column 4, lines 55-65).

***Conclusion***

23. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

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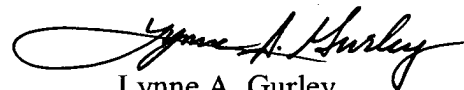
§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynne A. Gurley whose telephone number is 571-272-1670. The examiner can normally be reached on M-F 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Lynne A. Gurley  
Primary Patent Examiner  
TC 2800, Art Unit 2812

LAG  
January 21, 2005